

Optical Breath Gas Sensor for Extravehicular Activity Application

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The function of the infrared gas transducer used during extravehicular activity (EVA) in the current space suit is to measure and report the concentration of carbon dioxide (CO₂) in the ventilation loop. The next generation Portable Life Support System (PLSS) requires next generation CO₂ sensing technology with performance beyond that presently in use on the Shuttle/International Space Station extravehicular mobility unit (EMU). Accommodation within space suits demands that optical sensors meet stringent size, weight, and power requirements. A laser diode (LD) spectrometer based on wavelength modulation spectroscopy (WMS) is being developed for this purpose by Vista Photonics, Inc.

Two prototype devices were delivered to NASA Johnson Space Center (JSC) in September 2011. The sensors incorporate a laser diode based CO₂ channel that also includes an incidental water vapor (humidity) measurement and a separate oxygen (O₂) channel using a vertical cavity surface emitting laser (VCSEL). Both prototypes are controlled digitally with a field-programmable gate array (FPGA)/microcontroller architecture. Based on the results of the initial instrument development, further prototype development and testing of instruments leveraging the lessons learned were desired. The present development extends and upgrades the earlier hardware to the Advanced PLSS 2.0 test article being constructed and tested at JSC. Various improvements to the electronics and gas sampling are being advanced by this project. The combination of low power electronics with the performance of a long wavelength laser spectrometer enables multi-gas sensors with significantly increased performance over that presently offered in the EMU.

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